Directorate of Intelligence

~~Secret~~

25X1

H, F,
3

Psychological Research in Support of Soviet Long-Duration Manned Spaceflight

25X1

A Reference Aid

~~Secret~~

SW 82-10070
August 1982
Copy 356

Page Denied

Directorate of Intelligence

Secret [redacted] 25X1

Psychological Research in Support of Soviet Long-Duration Manned Spaceflight [redacted] 25X1

A Reference Aid

The author of this report is [redacted] Office of Scientific and Weapons Research. Comments and queries are welcome and should be directed to the Chief, Military Technology Branch, OSWR, [redacted] 25X1 25X1

This report has been coordinated with the National Intelligence Council. [redacted] 25X1

Secret
SW 82-10070
August 1982

 25X1

Psychological Research in Support of Soviet Long-Duration Manned Spaceflight 25X1

Summary

The Soviets learned from the Apollo-Soyuz Test Project (ASTP) with the United States that cosmonauts could do much more than they had been called upon to do during previous spaceflights. The recent Soviet successes with extended manned missions aboard Salyut-6 illustrate their finding. The Soviet manned space program, like that of the United States, has both military and civilian-scientific components. While the driving component is the military, the program incorporates and benefits from advances in the civilian-scientific sector. 25X1

Early Soviet manned spaceflights were almost entirely automated and demanded little of the cosmonauts. In recent years, the flights have been longer, have carried several crewmembers, and have called upon the cosmonauts to do numerous critical tasks. 25X1

The Soviets have concomitantly developed a substantial program of psychological research—"human factors engineering"—for manned spaceflight. This psychological research seeks to help Soviet cosmonauts improve their performance. Its studies reach into several areas: cosmonaut selection, testing, training, in-flight monitoring, and morale. Several research institutes participate in the program. It is conducted as part of a substantial biomedical research program and is coordinated through the Institute of Biomedical Problems, USSR Ministry of Health, Moscow. 25X1

The Soviets have established specific psychological criteria as a part of their selection standards for cosmonauts. However, these criteria and the associated testing probably are not useful in the selection process. First, the Soviets lack know-how in establishing and using psychological tests: most of their tests originated in the United States and have not been modified for the Soviet population; nor do the Soviets have the expertise to interpret test results. Second, the tests do not have much predictive validity. Third, the applicant pool is saturated with successful professionals (pilots, physicians, scientists, and engineers), and psychological tests do not have the precision that would furnish a basis for discriminating between such individuals. 25X1

Information available as of 1 July 1982 has been used in the preparation of this report.

Soviet biomedical specialists and psychologists are developing techniques to enhance and assess the "operational status" of their cosmonauts during spaceflight. Their research in this area is exploring three distinct approaches:

- The development of techniques to detect psychological stress by the evaluation of biomedical (electrophysiological) signals and/or voice patterns.
- Exposure to "high stress" during flight training in aircraft; the use of biofeedback and autogenic training exercises during spaceflight.
- The development of mathematical models of cosmonaut performance to predict more accurately the probability of cosmonaut error. 25X1

The Soviets are conducting, largely during spaceflight, psychological studies of the sensory, cognitive, and psychomotor alterations that may occur during weightlessness. The studies include:

- Visual acuity and depth perception experiments that describe alterations in eyesight that may occur during long-term weightlessness. A knowledge of such alterations would be relevant to such tasks as visual reconnaissance and detection, aiming, and tracking of targets in space.
- Circadian (24-hour periodicity) studies that quantify daily fluctuations in bodily systems that can affect a cosmonaut's adaptation to weightlessness and influence optimal scheduling of tasks during a given 24-hour cycle.
- Cognitive experiments that measure the ability to perform mental operations while subjected to weightlessness.
- Subjective questionnaires that ask the cosmonauts to evaluate their living conditions in space. Such experiments can have a positive psychological impact by providing useful information on the psychological environment and ways in which to improve it.
- Time estimation experiments.
- Hand-eye coordination experiments. 25X1

Soviet spacecraft design, to a much greater extent than US design, emphasizes simplicity of man-machine interaction. The design process is also continuing to refine the allocation of tasks (among crewmembers and between man and machine) for long spaceflights. Areas that have received attention in this allocation include: the influence of circadian rhythms; work, rest, and sleep schedules; the necessity for a period of adaptation to weightlessness; variety of tasks; and redundancy of crew duties. 25X1

25X1

In the near future, with the expansion of crew sizes and the permanent manning of larger space stations, crew compatibility will assume greater importance. Soviet psychological research in this area has drawn on the psychological study of individual (one-to-one) interactions in groups during extended isolation such as in polar expeditions and submarine patrols. In addition, the Soviets are searching out those important psychological variables that affect group performance. 25X1

Finally, we believe that the Soviets will continue their biomedical research program—including its psychological component—dedicated to the support of their manned space program. This research will, we believe, contribute considerably to their cosmonauts' achieving high duty cycles and high performance levels. 25X1

25X1

Contents

Appendixes

25X1

25X1

Tables

25X1

Figures

25X1

Psychological Research in Support of Soviet Long-Duration Manned Spaceflight 25X1

Introduction

Early Soviet manned spaceflights (which started in 1961) were almost entirely automated and demanded little of the cosmonauts. In recent years, Soviet manned spaceflights have been longer and longer, have carried several crewmembers, and have called upon the cosmonauts to do numerous critical tasks. Psychological problems inherent in long spaceflights have, accordingly, taken on increasing importance in the Soviet manned space program. Research into the psychological aspects of the selection, testing, training, in-flight monitoring, and morale of cosmonauts has become extensive.

Psychological Criteria for Selection of Cosmonauts

In scientific exchanges with NASA scientists the Soviets have stated that, from the beginning, Soviet biomedical standards for the selection of cosmonauts have included psychological criteria (also applicable to their Interkosmos—non-Soviet—cosmonauts). These criteria include five specifics.

First, the examiners identify individuals who possess "high mental efficiency." This objective is accomplished primarily by administering intelligence tests.

Second, they describe each applicant's personality. The emphasis is on detecting "borderline" psychopathological personality traits that might surface under stress. In addition, they measure, primarily by standard personality tests, an applicant's motivation for spaceflight.

Third, they determine which individuals work effectively in a group. To this end, they study actual "group activity," assess crew compatibility, and look at the "social background" of applicants.

Fourth, they measure psychomotor coordination, by administering hand-eye coordination tests and tests that measure "the ability to shift attention" from one task to another. 25X1

Fifth, they quantify the "central nervous system (CNS) reserves under stress." ("CNS reserves" is a Soviet term for "individual response stereotypy" (IRS)—see appendix A.) They do so by measuring various electrophysiological channels (for example, an electrocardiogram—EKG) when the individual is under physiological or psychological stress. These measurements can be correlated with the real-time assessment of the same individual on duty during actual spaceflight. 25X1 25X1

To apply these five criteria, the Soviets include a psychological testing program in their biomedical examination of cosmonaut candidates. 25X1

Psychological Testing

Oleg G. Gazenko, director, Institute of Biomedical Problems, USSR Ministry of Health, Moscow, has described the biomedical examination for selection of cosmonauts. The physical examination is done in three stages. The first or primary examination—the polyclinical stage—is conducted at various clinics and reviews all major physiological systems. At this stage, one of two recommendations is made: "suitable for physical examination" or "not suitable for physical examination." Those who pass take a second medical examination at "specialized clinical facilities." During this part of the medical procedure, specialists psychologically evaluate cosmonaut applicants. After this second medical examination, they categorize the applicants as "suitable," "unsuitable," or "temporarily unsuitable" (where brief treatment—not more than one month—should alleviate any discovered deficiency). The third medical examination is given during training at the Yuri A. Gagarin Cosmonaut Training Center near Moscow.

25X1 25X1 25X1 25X1 25X1

Through a review of the scientific literature and presentations made at scientific conferences, we have evidence that the Soviets coordinate the use of psychological tests with other East European psychologists. These include scientists from the Psychology Institute, Hungarian Academy of Sciences; the Psychodiagnostika Institute, Czechoslovakian Ministry of Education; the Czech Research Institute of Psychiatry, Prague; and the Polish Military Institute of Aviation Medicine, Warsaw. We do not know the exact nature of the psychological criteria for the Hungarian and Czechoslovak cosmonauts. However, S. Baranski, Z. Gierowski, and K. Klukowski have described the psychological input into the preliminary selection of Polish cosmonaut candidates. Their description of the Polish psychological tests parallels closely that of the Soviet tests. They measure "mental efficiency," rate of intellectual work, sensory capabilities, "emotional resistance to stress," "individual psychophysiological reactivity to stress" (CNS reserves under stress), personality traits, and motivation for spaceflight. Both the Poles and the Soviets have listed similar psychological criteria. These include a "low manifest anxiety," high intelligence, good memory and attention, and "resistance to mental fatigue." Both also state a preference for "extraverted" (socially outgoing) individuals.

The Soviets depend largely—to a surprising degree—upon Western (primarily American) psychological tests in this portion of the cosmonaut selection process.

Assessment of the Soviet Psychological Testing Program

The program evidently has several shortcomings.

First, Western experience in the difficulties of test development suggests that the Soviet psychological testing program, which has adopted Western (mostly American) tests without modifying them for the Soviet population, may be of limited utility. This problem may exist more for personality tests than for intelligence tests. The Soviets—and, to a lesser extent, the Poles, Czechoslovaks, and Hungarians—lack experience in psychological testing. Since 1936 there has been an official ban on the use of psychological tests within the Soviet Union. This ban has only recently been lifted for isolated applications (to include the Soviet manned space program). But psychological testing demands a high degree of expertise, especially in interpreting test results. We believe that, because of their lack of know-how in establishing and using tests, the Soviets derive only limited and even dubious benefit from their test results. 25X1

Second, there is the question of test "validity" and test "reliability." These terms describe whether a psychological test actually measures what it is supposed to (validity) consistently (reliability). In particular, the test should possess both "construct" and "predictive" validity. Construct validity refers to how well the test actually measures the psychological construct of interest (for example, intelligence, anxiety, extraversion). Predictive validity, especially important within the present context, refers to the ability of a test to predict performance accurately (so that those applicants who score high should perform cosmonaut activities well, while those who score poorly should not). Soviet psychological tests do not have much predictive validity. From a review of recent Soviet scientific literature, we have preliminary evidence that the Soviets are engaged in a research program to establish the predictive validity of at least one of their tests (the MMPI) but not of the psychological test battery as a whole. 25X1 25X1

In one important area—the optimal selection of multimember crews—there is no Soviet data base for correlating psychological test results with readier compatibility or enhanced performance of crews. Assuming, however, that such a data base is being built up during the evolution of ever-longer Soviet manned spaceflights, the practicality of psychological testing for these cosmonauts could become substantial within the next decade. 25X1 25X1 25X1

Third, the Soviet applicants are successful, high-caliber individuals (military pilots, engineers, physicians, and scientists). Psychological tests do not have the precision that would furnish a basis for discriminating between such individuals. While individual differences in applicant scores on these intelligence and personality tests do exist, we believe that the tests have little utility in the selection of cosmonauts. 25X1

Vestibular Research and Training Program

The Soviets admit that between 30 and 40 percent of their cosmonauts have had motion sickness during spaceflight. This percentage range is similar to that in the American experience. Scientific exchanges and conferences indicate that Soviet scientists are continuing research into the development of space motion sickness in order to reduce or eliminate it. Because space motion sickness has both physiological and behavioral consequences, the Soviet research is interdisciplinary. Present theory, concentrating on the interaction of various sensory systems, holds that visual and vestibular systems send conflicting information to the brain during weightlessness. Visually the spacecraft presents "up" and "down" signals, but vestibularly it does not. The brain is confused. Consequently, the cosmonaut experiences the symptoms of motion sickness. [redacted]

Because their cosmonauts continue to experience motion sickness during spaceflight, the Soviets have recently stated to their NASA counterparts during scientific exchanges that they continue to emphasize vestibular testing. These tests seek to determine the susceptibility of cosmonaut candidates to vestibular stress. In addition, individualized vestibular exercises are given to the cosmonauts during training. [redacted]

Vestibular Testing

Vestibular testing is done during the second medical examination in the cosmonaut selection process. Vestibular function is examined during the otolaryngological investigation. Tolerance to vestibular stress is then determined by 15-minute tests on parallel Khilov swings, by exposure to Coriolis (cross-coupled) acceleration for 10 minutes, and by centrifuge testing: acceleration of plus 5GZ for 30 seconds, and acceleration of plus 8GX for 40 seconds (see appendix A). [redacted]

The Soviets have told NASA scientists that cosmonaut candidates are categorized as exhibiting a "sharply pronounced degree of sensitivity" (that is, as susceptible—about 30 percent of the candidates), an "average degree of heightened sensitivity" (that is, as partially susceptible—about 50 percent), or a "slightly increased sensitivity" (that is, as not susceptible—about 20 percent). The 30 percent who are susceptible fail the selection process. Those who are partially susceptible are scheduled for an individualized vestibular training program aimed at increasing vestibular tolerance. Those who show little susceptibility to motion sickness undergo a minimum of vestibular training. [redacted] 25X1

Vestibular Training

Oleg Gazenko told NASA scientists that vestibular training for Soviet cosmonauts is individualized, being based on the results of vestibular testing. Training is both "active" and "passive." "Active" training consists of rigorous physical conditioning through such activities as swimming, jogging, and gymnastics. The philosophy behind it is that excellent physical condition contributes to vestibular tolerance. The "passive" training program involves habituation exercises in a Barany chair (figure 1), Khilov swings, and vertical oscillators. It continues exposure to vestibular stimulation until some disorientation is felt. The Soviets claim that these brief exposures increase a cosmonaut's ability to withstand vestibular stimulation. (Stanislaw Baranski, Polish Institute of Aviation Medicine, describes a similar procedure for vestibular training of Polish cosmonaut candidates.) The Soviets define improvement in tolerance to vestibular stress as improved tolerance to Coriolis acceleration. [redacted] 25X1 25X1 25X1

Continuing Vestibular Research

A review of the scientific literature shows that vestibular research continues within the Soviet manned space biomedical research program, primarily because space motion sickness remains difficult to prevent. Several lines of research are continuing. They include:

- Centrifuge research (under Ye. B. Shul'zhenko of the Institute of Biomedical Problems, Moscow). This research is studying the possibility of producing artificial gravity by slow rotation of a short-arm centrifuge within a space station (which would also subject a cosmonaut to a Coriolis force). 25X1

- Weightlessness studies using long-term bed rest, long-term head-down tilting, and water immersion.

Figure 1

Barany Chair

587286 8 82

25X1

- The use of certain drugs to relieve motion sickness. So far such efforts have met with only limited success. Drugs have produced relief principally by their tranquilizing effect. This result may be unsuitable, especially during a period when operator performance is required.

- Restriction of movement during the initial adaptation stage of spaceflight, since increased movement will accentuate any experienced motion sickness.

- The use of biofeedback and autogenic training procedures to help a cosmonaut handle any perceived disorientation.

25X1

Psychological Preparation for Spaceflight

Soviet biomedical specialists and psychologists provide psychological training to prepare their cosmonauts to handle possible life-threatening stresses and

unforeseen accidents. With long spaceflights becoming increasingly frequent, we believe that such training will continue.

Psychological Training Program

Soviet psychological training exposes cosmonauts to "real life" dangers to develop coping behavior. Soviet scientists have continually stated that only exposure to actual stress can adequately develop the psychological motivation, physiological conditioning, and behavioral strategies that, when combined through training, can help the cosmonaut cope with danger. The Soviet psychological training program has been modified over time, primarily on the basis of experiences on earlier spaceflights. The following procedures have been used.

Flight Training. Flying is used because of the obvious similarities between spaceflight and aircraft-flight skills. In addition, flying can present crises that call for pilot resourcefulness. Former cosmonaut Maj. Gen. A. A. Leonov has stated that MIG-21 Fishbed fighters, L-29 Maya jet trainers, helicopters, and VTA (believed to be high-altitude) aircraft have been used.

Parachute Training. Though once a vital part of cosmonaut training (for example, over 40 jumps per year were required of each trainee, according to Leonov), parachute jumping has been deemphasized. However, Lt. Gen. Georgiy T. Beregovoy, chief of training at the Gagarin Cosmonaut Training Center, Star City, and a number of psychologists from the Institute of Psychology, Moscow, continue to specify parachute jumping for cosmonaut stress research. In such jumping, the cosmonaut is required to perform various perceptual and cognitive tasks during free fall. With continued practice, performance at these tasks improves measurably as the cosmonaut becomes habituated to the perceived stress. Indications are that parachute jumping for cosmonauts is now used primarily to test psychophysiological monitoring techniques that are being developed to assess psychological stress and related performance.

Isolation. Isolation of cosmonauts prior to a spaceflight was a procedure used early in the Soviet manned space program to prepare them for the isolation that they would experience in space. The Soviets have said that this procedure has been discontinued.

25X1

25X1

Survival Training. The Soviets continue to incorporate survival training exercises as a part of the training of their own cosmonauts, but not for their Interkosmos counterparts. The Soviets have stated that this survival training was invaluable for the survival of Soviet cosmonauts on two occasions: the attempted Soyuz-18 flight of Vasiliy Lazarev and Oleg Makarov in April 1975, when they landed on a slope of snow-covered mountains; and the Soyuz-23 flight of Vyacheslav Zudov and Valery Rozhdestvensky in October 1976, when they landed on a partially frozen lake. In both instances, rescuers were several hours in coming to their aid and were fearful for the cosmonauts' lives. General Beregovoy stated that on both occasions the cosmonauts had survived primarily because of the skills that they had learned during their psychological training.

25X1

25X1

The Soviets describe three scenarios for survival training. All three involve transporting the cosmonaut trainees into a physically hostile environment. One consists of removal to an isolated arctic location where temperatures may fall to −40 to −45 degrees Celsius. Another scenario uses the desert. A third uses mountains. In all of these scenarios, the cosmonauts are expected to survive as long as possible—typically a couple of days—with the supplies normally carried in their Soyuz spacecraft.

25X1

25X1

Beregovoy states that one skill taught to their cosmonauts is body temperature control through biofeedback. Another skill is reduced oxygen consumption, taught by techniques very similar to transcendental meditation. Beregovoy stated that reduced oxygen consumption was the primary reason for the survival of cosmonauts Zudov and Rozhdestvensky. Their Soyuz spacecraft had only a four-hour air supply, because the air vents of the craft stayed locked shut for the 12 hours before rescuers arrived.

25X1

25X1

Psychological Support, Crew Compatibility, and Research Into Group Dynamics

The Soviets, in discussions with NASA officials, have stated that the biggest problem they envision for long spaceflights will be psychological. A major factor in

this problem continues to be boredom and isolation. Under the auspices of the "Psychological Support Group" (located at the Flight Control Center) of the Institute of Biomedical Problems, the Soviets have initiated measures to cater to the psychological needs of their cosmonauts in flight. The measures, which the cosmonauts have praised, include:

- A varied diet (to include fresh fruit).
- Videotaped television programs.
- Recorded music.
- Reading materials (requested and "surprise" selections).
- Communication with family members, Soviet celebrities, and friends.
- Scheduled free time.

Visits from the Interkosmos crews, also, are said to be very rewarding psychologically. [redacted]

Of increasing concern is the need for better specification of crew compatibility requirements. Soviet biomedical and behavioral scientists see crew compatibility as a major variable in the success of long spaceflights. The Soviets are devoting substantial research to it. One approach is to form crews on the basis of individual psychological profiles and of assumptions about interaction between certain personality types. The Soviets state that this approach has not been entirely successful. Currently their approach is to study compatibility during training and match those cosmonauts who interact best with one another. [redacted]

The Soviets are also conducting research on the effects of group dynamics on the behavior of individual cosmonauts. This research is most applicable for long space missions involving several crewmembers (for example, a permanently manned Earth-orbital space station). The psychological dynamics of a large group in space is currently an area in which no actual experience exists. Therefore, Soviet scientists have studied the group dynamics of isolated multimember crews in submarines, on board naval surface ships, on polar expeditions, and in long-range bombers. Positive correlations between the psychological environment of spaceflight and these other group situations are well known and should provide heuristic information concerning group and individual behavior in long spaceflights. [redacted]

Techniques for Monitoring the Condition of Cosmonauts in Flight

Manned spaceflight demands that cosmonauts maintain an acceptable level of in-flight performance. This performance will tend to decline within hours or days, especially as spaceflights become longer. The Soviets, in response to this problem, have had an extensive research program to develop techniques to remotely monitor their cosmonauts, to detect physiological and psychological stresses, to assess the impact of such stresses upon performance, and to cope with stress. [redacted] 25X1

25X1

Psychophysiological Recording

Beyond an "optimal" level of psychological stress (some stress is desirable), performance will decrease as stress increases. Ideally, the ground support personnel would be able to detect this stress before any performance decrement went very far. They could then intervene and maintain the cosmonaut's working efficiency at, or restore it to, an acceptable level. While the exact relationships have not yet been well specified anywhere in the scientific world, Soviet scientists are aware that any psychological stress is accompanied by simultaneous physiological changes. Accordingly, they are developing techniques for monitoring their cosmonauts physiologically, and for thus detecting psychological stress, in real time. One such technique is the use of electrophysiological (Soviet term: "psychophysiological") signals. Some major types of signals are already being monitored by means of the following records: electroencephalogram (EEG), galvanic skin response (GSR), electromyogram (EMG), electrocardiogram (EKG),[1] and rheographic analysis (the study of the distribution of body fluids, which is altered under weightlessness). [redacted] 25X1

25X1

This technique has several advantages. One is that electrophysiological signals, already collected for biomedical evaluation, can be used without any additional equipment. Psychophysiological research only requires access to these signals by different scientists (that is, those primarily interested in the relationship between psychological stress and physiological reactivity). In addition, these electrophysiological signals

[1] See appendix A for definitions.

25X1

are quite large, easy to detect and record with present instrumentation, and amenable to computer analysis.

Recording for psychophysiological research does, however, present several problems. Some techniques may be invasive and unpleasant even for short periods. Even for noninvasive psychophysiological monitoring, recording for extended periods may be confining and uncomfortable. There are, in addition, two major theoretical problems that may be difficult to overcome. The first is "individual response stereotypy." This term denotes an individual's specific pattern of physiological responses to different stressors. To be fully valid, a psychophysiological assessment would have to be based upon the completely developed pattern of a cosmonaut's physiological responses so that the appropriate physiological channels could be monitored (these channels will differ for each cosmonaut). The second and probably more difficult problem is the lack of any well-established correlations between psychological states and physiological responses. We believe that until those relationships are well defined, the value of psychophysiological monitoring to predict cosmonaut performance will be uncertain.

Voice Analysis

Deviations in voice characteristics are also widely credited with being an indication of speaker stress. Consequently, a second Soviet psychological assessment technique being explored is voice analysis. Voice monitoring analyzes a speaker's voice characteristics during both calm and stressful periods to determine changes that occur during stress. The voice/speech characteristics that the Soviets study include changes in pauses (both length and number), vocabulary, voice spectrogram analysis (volume and pitch), and the introduction of stuttering. The Soviets have a long history of research in the area of voice analysis. At a USSR Academy of Sciences all-Union conference entitled "Speech, Emotions, and Personality" held in Leningrad in 1978, several researchers associated with the Soviet manned space program presented papers. In addition, the Institute of Psychology, USSR Academy of Sciences, in holding a symposium in 1979 on the psychological aspects of manned spaceflight, included a presentation on voice analysis.

Researchers from several different scientific institutes that have input into the Soviet manned spaceflight program conduct voice analysis 25X1

25X1

During a Soviet/East German Interkosmos spaceflight, the cosmonauts conducted the Rech' (speech) experiment. This was a psychological study of the connection between a cosmonaut's speech and his emotional (that is, psychological) condition. In this experiment, scientists analyzed (with results unknown to us) a single phrase said repeatedly by the crew throughout the flight. 25X1

Voice analysis has advantages over psychophysiological monitoring. It can be used without the knowledge or consent of a cosmonaut, and can be used to study a variety of voice characteristics. Deception by the cosmonaut is almost impossible. In addition, voice analysis need only use already-recorded voice telecommunications. As with psychophysiological monitoring techniques, however, the correlation between voice characteristics, stress, and future cosmonaut performance is not well defined. As the Soviets continue their work in voice analysis, they should improve such correlation. 25X1

25X1

Biofeedback Research

Soviet and East European psychologists and physiologists have a long history of exploring the use of biofeedback for the management of certain stresses. Among these stresses are motion sickness, sleep disturbances, and strains on crew compatibility due to confinement. 25X1

The Soviets have been interested for several years in the applicability for their cosmonauts of biofeedback and of responses to it: autogenic training, habituation, and relaxation techniques. Biofeedback and related responses are an alternative to psychopharmacological approaches (which often produce undesirable side effects) for stress management. 25X1

Biofeedback develops the ability to consciously control one's physiological reactions. Biofeedback training involves connecting a person to electrophysiological instrumentation that monitors some specific

25X1

physiological channels, amplifies the signal from each, and conveys it back to the person visually or aurally. As the signal (for example, the heart rate) fluctuates, so will the feedback. Simultaneously with this feedback signal, the person is taught mental and physical exercises to achieve relaxation and thereby alter the physiological reaction. The display will immediately reflect the altered reaction. For instance, a person can, with the aid of biofeedback, increase or decrease his heart rate or raise or lower the temperature of specific parts of the body through vasodilation or vasoconstriction. The exact mechanism of this phenomenon is unknown, but biofeedback procedures have been well demonstrated (especially within clinical settings) for many years.

The chief Soviet proponent for the applicability of this research to astronautics has been Pavel V. Simonov, chief of the Physiology of Emotions Laboratory, Institute of Higher Nervous Activity and Neurophysiology, Moscow, in collaboration with several biomedical specialists from the Institute of Biomedical Problems, Moscow. These scientists have occasionally met with NASA scientists who also are working on biofeedback research applicable to astronautics. They have told NASA scientists that they and their cosmonauts have used biofeedback successfully to combat motion sickness and accompanying vestibular disturbances—which remain major complications of spaceflight, especially during the initial adaptation period (the first seven to 10 days). Dr. Aleksandr Romen,

25X1

Department of Biophysics, Kazakh State University, has engaged in a related research project, one on the development of "psychical self-regulation" (PSR). According to Dr. Romen, PSR techniques were originally developed to train cosmonauts in "self-regulatory skills." In addition, Hungarian psychologists from the Institute of Psychology, Hungarian Academy of Sciences, have been exploring the possibility of using biofeedback to counter the stressful effects of weightlessness and hypokinesia. [redacted]

Biofeedback and related autogenic training for stress management have potential advantages over other techniques. Although electrophysiological instrumentation is required during biofeedback training, it would not be required after the procedure has been learned (that is, during spaceflight). Biofeedback and related responses can produce a sense of mastery for the cosmonaut and reduce the feeling of helplessness that is common during stress. [redacted]

Sensory, Cognitive, Psychomotor, and Psychological Alterations During Spaceflight

Spaceflight imposes a unique environment of microgravitation, hypokinesia, and physical isolation for increasingly long periods. The Soviets, under their basic biomedical research program, have conducted a series of experiments to detect and quantify any alterations during spaceflight in sensory capabilities, cognitive functioning, psychomotor skills, and psychological well-being (table 2 and appendix C). In doing so, they have worked with East European and Cuban scientists brought in through the Interkosmos program, coordinated by the Institute of Biomedical Problems, Moscow. [redacted]

Experience with shorter spaceflights suggests that sensory alterations may occur in flight. For example, Lyakhov and Ryumin noted an "intensification of smell" upon their return to Earth after their 175-day mission in 1980. Other cosmonauts have mentioned an "intensification of taste and smell" *during* their spaceflights. A. Yeliseyev, a cosmonaut on board Soyuz-5, -8, and -10, commented on a fluctuation in his visual acuity during spaceflight: acuity decreased during the initial adaptation period but steadily improved until it was normal after two months in space. Lt. Gen. Georgiy T. Beregovoy has stated that his perception of time was altered during spaceflight.

[redacted] 25X1

Ergonomic Input Into Soviet Manned Spacecraft Design

Design for Man-Machine Interaction

The Soviets have a good understanding of human factors principles (ergonomics), which assume great importance in complex man-machine systems, such as the Soyuz and Salyut spacecraft. The Institute of Psychology, USSR Academy of Sciences, has a major interest in human factors aerospace research and is a known consultant institute for the Soviet manned space program. It is to be expected that this expertise actually enters into task analysis, spacecraft and equipment design, controls and displays layout, and work configuration. Given this Soviet expertise, and a limited knowledge of actual Salyut and Soyuz control panels, a preliminary hypothesis can be entertained that their layout may give clues to Soviet philosophy on the allocation of tasks to cosmonauts. [redacted]

25X1

25X1

25X1

An example of control panel design is available from an examination of the Salyut-6 space station at the 1979 Paris Air Show (figure 2). Some standard human factors design features have been incorporated into the panel. They should aid ease of operation and reduce errors. They include "switch guards" to prevent inadvertent switching, "boundary enclosures" for groups of switches with similar function, and other such features. Control panel arrangement is not optimized, however, and much "dead space" exists between many control panels, at least in this Salyut-6 mockup. [redacted]

25X1

25X1

The main control panel in the Salyut-6 space station is an exact replica of that in the Soyuz spacecraft, and so facilitates transfer of crewmembers between the two. It differs substantially, however, from the new Soyuz-T main control panel. (We do not know whether the main control panel of the new Salyut-7 space station will assume the new Soyuz-T configuration to make the transfer of crew from Soyuz-T to Salyut-7 that much easier.) See figures 3 through 7. Compared

Table 2
Recent Psychological Experiments During Soviet or Interkosmos Spaceflights [a]

Name of Experiment	Description	Cosmonauts Involved [b]
Sensory		
Neptun	Visual acuity and depth perception	Soviets, Romanian, and Mongolian
Guler/Vorotnik	Development of motion sickness	Soviets and Romanian
Ancheta	Description of vestibular system symptomology	Soviets, Romanian, and Cuban
Vospriyatiye	Measurement of several sensory functions (for example, touch and "resistance to geometric illusions")	Soviets, Cuban, and Mongolian
Vremya	Time estimation	Soviets and Mongolian
Audio	Auditory thresholds	Soviets, East German, and Hungarian
Vkus	Electrical taste	Soviets and Pole
Vision	Functional state of the visual system	Soviets and Cuban
Cognitive		
Operator	Psychophysiological measurement of cognitive functioning	Soviets, Bulgarian, and Romanian
Rabotosposobnost'	Psychophysiological measurement of intellectual working ability	Soviets, Hungarian, Cuban, and Mongolian
Reflex	Cognitive functioning	Soviets, Romanian, and Hungarian
Cortex	EEG measurement	Soviets and Cuban
Psychomotor		
Antropometria	Motor function after body fluid redistribution	Soviets and Cuban
Coordination	Motor functioning under weightlessness	Soviets and Cuban
Psychological Well-Being		
Opros	Psychological questionnaire	Soviets, Hungarian, Pole, and Mongolian
Dosug	Evaluation of TV programs	Soviets and Pole
Relax	Relaxation through biofeedback	Soviets and Pole
Pruzkum	Psychological questionnaire	Soviets, Czechoslovak, and (?) Mongolian

[a] This table was compiled from various open-source publications (newspapers, magazines, and scientific journals.)
[b] Only one non-Soviet cosmonaut was aboard any given Interkosmos flight. Some of the flights handled more than one experiment; some of the experiments were performed on more than one flight, including some all-Soviet flights.

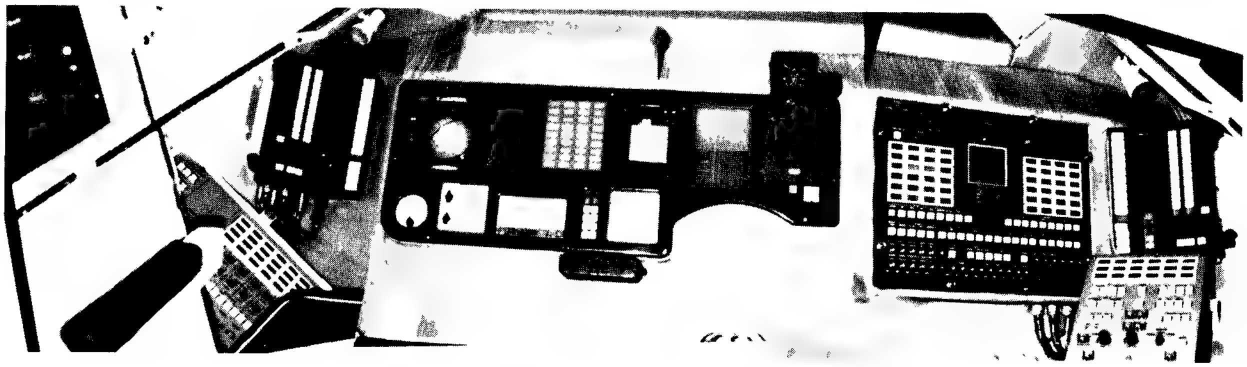
25X1

with the American Apollo and space shuttle control panels, the Soviet control panel seems uncomplicated. Only minimal displays and control devices are evident. Such panel design most probably is based on an analysis of those cosmonaut tasks that are unavoidably necessary during orbit, spaceflight, and deorbit. It supports our impression that many of the required commands during maneuvers either will remain with ground controllers or will remain highly automated, whichever is now the case. 25X1

Soviet spacecraft design engineers have stated that the new Salyut-7 space station will be reconfigured to improve accessibility of various equipment and system components and for ease of maintenance and repair. 25X1

Figure 2

Main Instrument Panel in the Salyut-6 Space Station



Note the similarity between the Salyut main instrument panel and that of the Soyuz (figure 3), and compare with the changes made in the Soyuz-T panel (figure 6).

25X1

587287 8 82

Allocation and Scheduling of Crew Tasks

We believe that the tasks for Soviet cosmonauts are planned to meet six needs:

- Scientific experimentation (materials processing under weightlessness to obtain highly specialized substances of a purity and composition, or of a size, unobtainable by Earth-based processing; biomedical, botanical, and life support system development).
- Reconnaissance (natural resources, military, and astronomical).
- Equipment and space station maintenance/repair requirements.
- Medical monitoring of crewmembers.
- Psychological factors—to include rest, relaxation time, and recreation.
- Physiological requirements—eating, personal hygiene, sleep; physical exercises (primarily to control the adverse physiological effects of prolonged weightlessness). 25X1

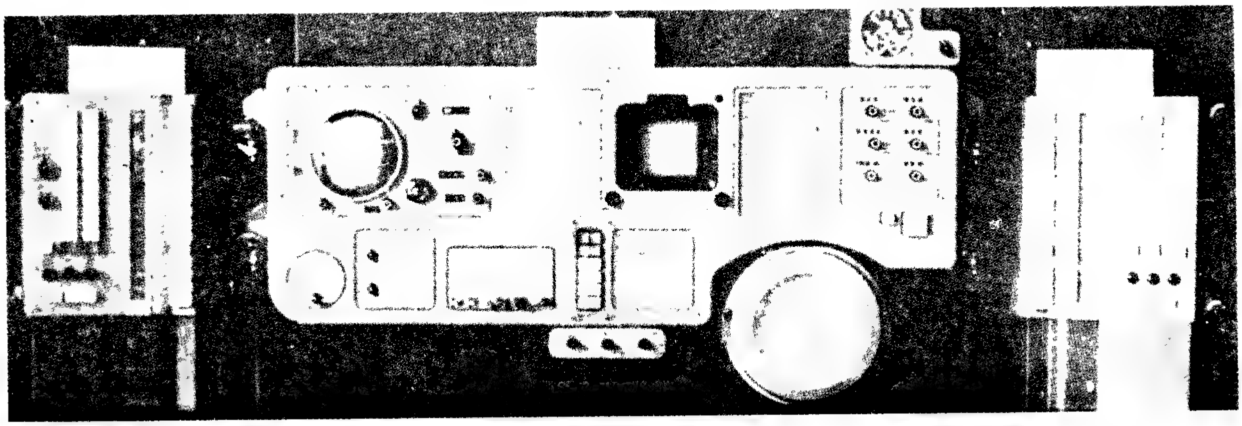
The Soviets appear to have refined their allocation and scheduling of tasks satisfactorily to meet these needs. Drastic changes should not be expected for their future manned spaceflights, but there may be further "fine-tuning," especially to enhance the psychological climate of long spaceflights. 25X1

Future Progress

The Soviets have shown that man, at least for the present, is not the limiting factor for long manned spaceflights. We believe that the Soviets will continue their biomedical research program—including its psychological component —dedicated to the support of

Figure 3

Main Instrument Panel in the Soyuz Spacecraft



25X1

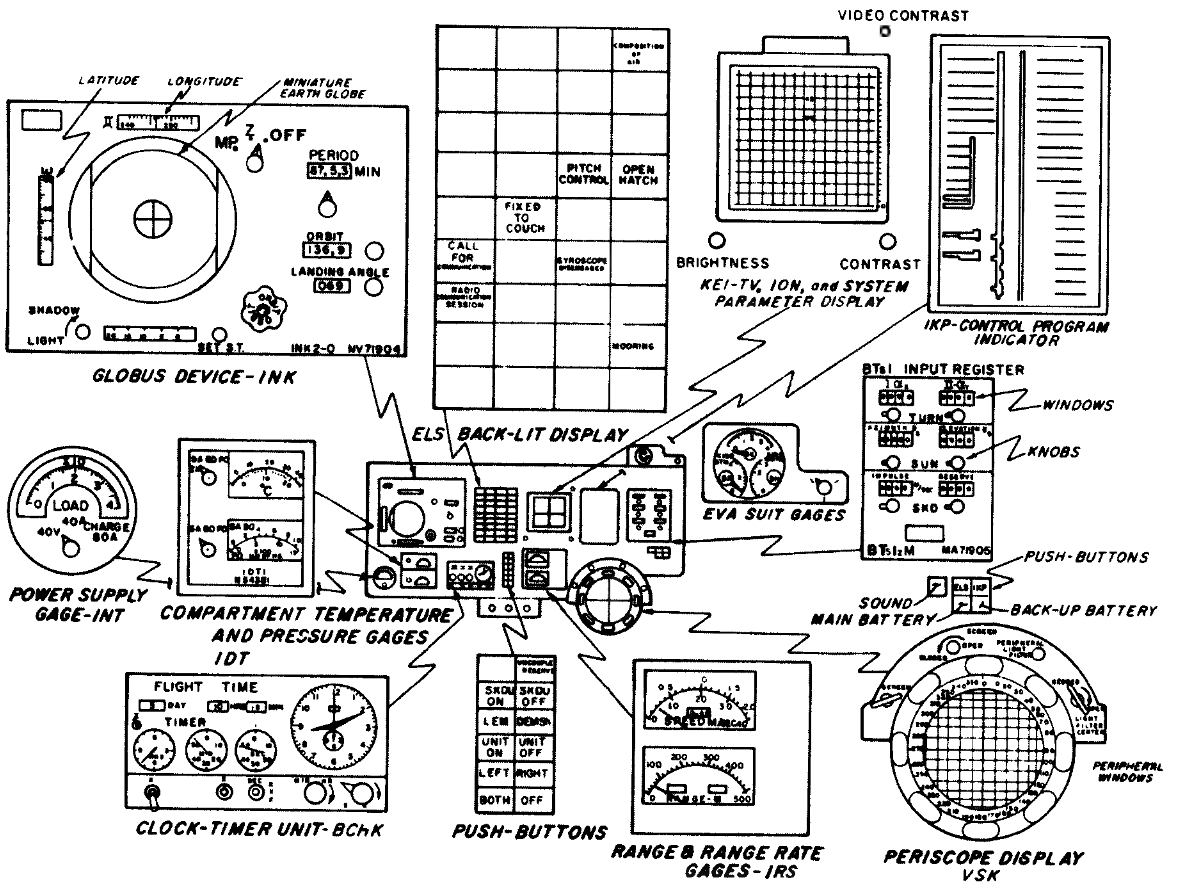
587288 8-82

their manned space program. Soviet space officials have stated that they foresee permanently manned space stations. We believe that their cosmonauts will stay in space for approximately three to four months and be replaced individually in a staggered sequence. During such a long stay in space, a cosmonaut can set aside time for adaptation to weightlessness, devote the greater part of his time to necessary tasks, and endure the limiting effects of isolation, hypokinesia, sensory deprivation, and boredom. Finally, we believe that the Soviets' biomedical research will contribute considerably to their cosmonauts' achieving high duty cycles and high performance levels.

25X1

Figure 4

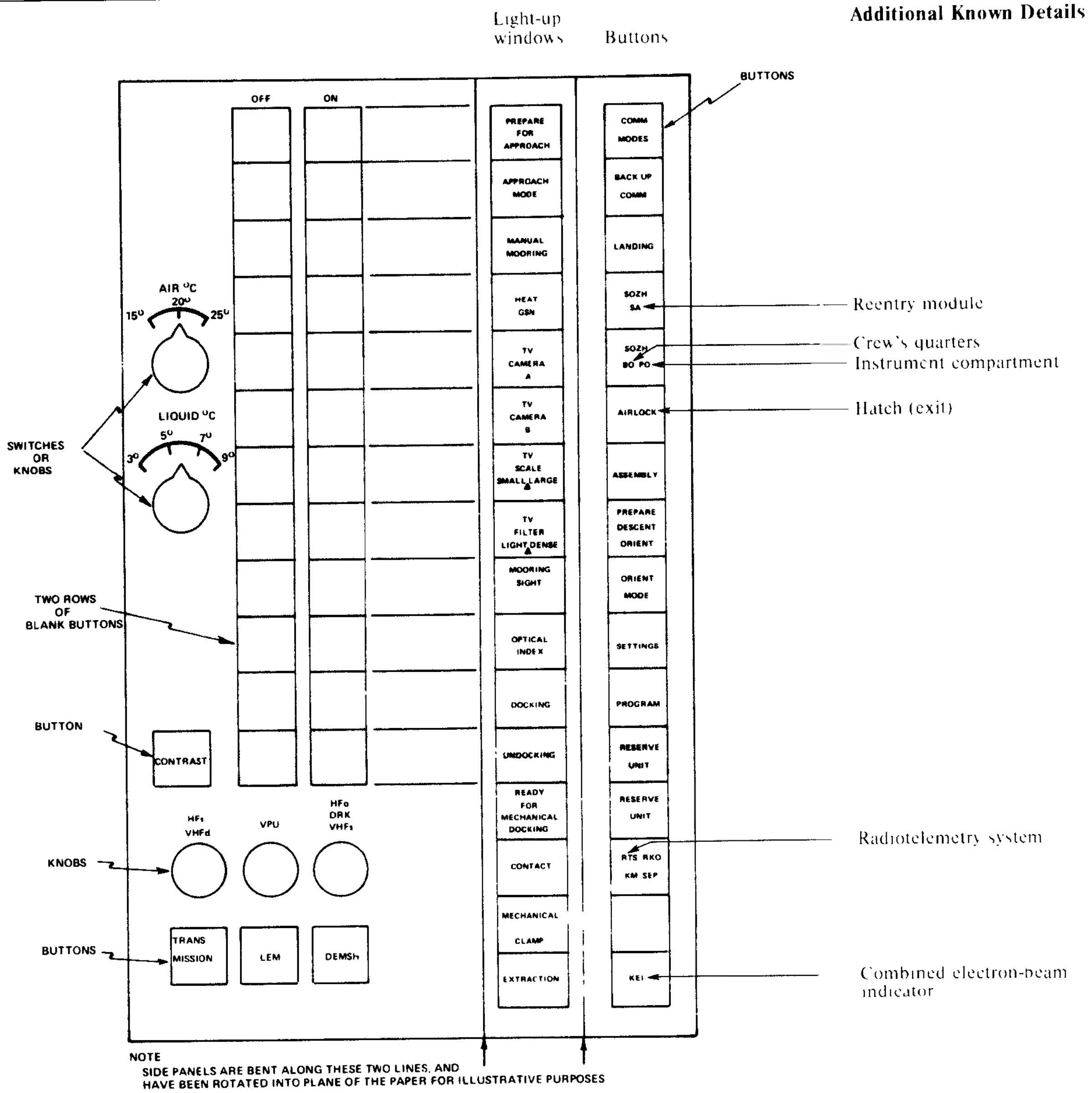
Center Console—Main Instrument Panel, Soyuz Spacecraft



[redacted] 25X1

587289 8 82

Figure 5
Left-Hand Command Signal Device (KSU) Monitoring 16 Subsystems—Main Instrument Panel, Soyuz Spacecraft

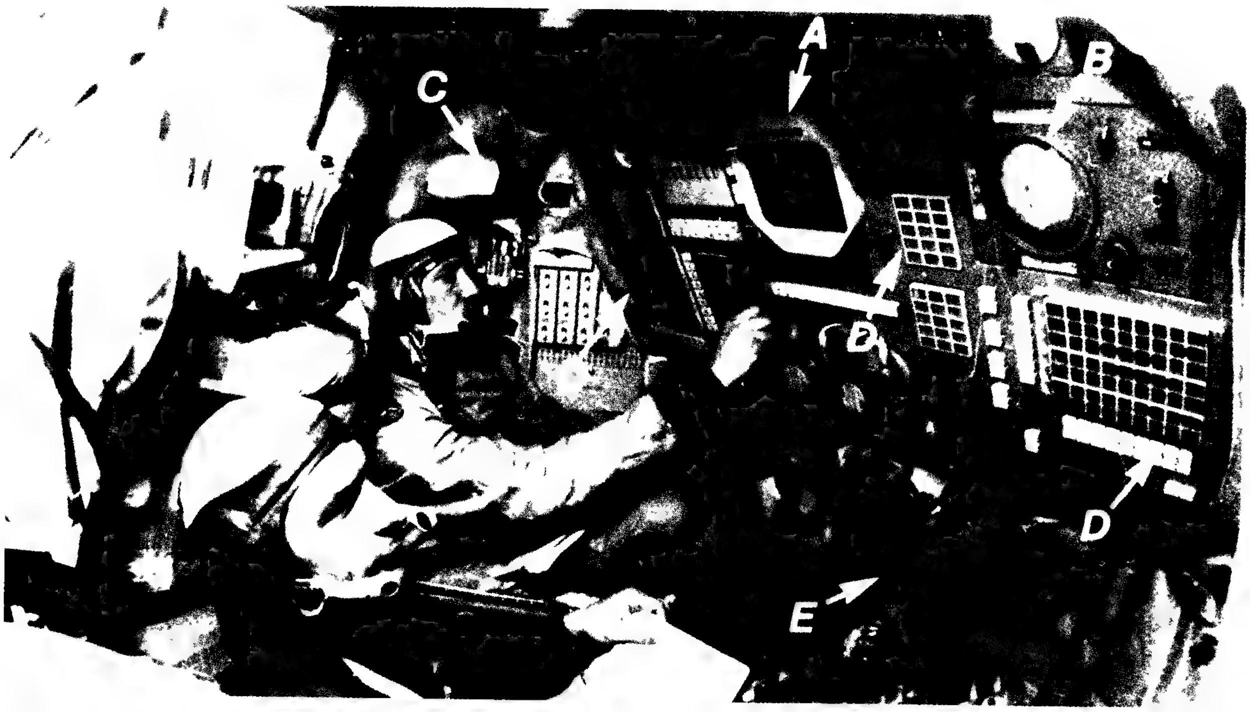


587290 8 82

25X1

Figure 6

Main Instrument Panel in the Soyuz-T Spacecraft



Note that a cathode ray tube computer display (A) has been added and the world drive scope on which spacecraft position over the Earth can be determined (B) has been moved from the left to the right side of the panel. Box-like analog sequencers formerly positioned at (C), which drove many spacecraft functions, have been removed entirely from the Soyuz-T. Several dials have been removed from the panel and replaced by nearly triple the number of buttons or annunciator panels (D) as in the older Soyuz design. The new Soyuz-T still provides the cosmonauts very little information and piloting control compared to earlier US Gemini and Apollo spacecraft. The Soyuz T is still not equipped with an eight-ball attitude indicator, and the crew must determine attitude by looking through their periscope (E).

25X1

58729 8-82

Figure 7

Main Crew Compartment in the Salyut-6 Space Station

25X1

587292 8 82

Appendix A

Glossary

Autogenic training	A self-regulatory technique in which subjects are taught a series of self-suggestion exercises. Each exercise is designed to induce some specific bodily sensation that ordinarily is the product of a specific physiological response. The subject is then taught to gain control of such previously involuntary responses, thereby reversing the ordinary cause-and-effect sequence.
Barany chair	A chair (named after the Swedish physician Robert Barany) in which the occupant is revolved, with or without simultaneous tilting, to test his susceptibility to vertigo.
Biofeedback	A technique by which a person can be taught to change and control internal body processes formerly believed to be involuntary (for example, blood pressure and brain waves); it involves giving the subject immediate feedback or knowledge of the bodily changes as they occur.
Cattell 16-PF	A nonprojective psychological test that measures 16 personality characteristics to create a personality profile.
Coriolis acceleration	Cross-coupled acceleration; occurs when a person is subjected to angular acceleration in two planes simultaneously.
Electrocardiogram (EKG)	An electrophysiological signal that records the changes in electrical potential that occur during the heartbeat.
Electroencephalogram (EEG)	An electrophysiological signal that measures brain waves.
Electromyogram (EMG)	An electrophysiological signal that records the change in electrical potential associated with the activity of skeletal muscles.
Galvanic skin response (GSR)	An electrophysiological signal that measures the change in electrical resistance (or conductance) for an electric current through the skin between two electrodes.

GX	Acceleration along the x-axis. Acceleration can be either positive or negative. Positive GX acceleration is "forward" with a resultant inertial force from the chest to the back. Negative GX acceleration is "backward" with a resultant inertial force from the back to the chest.
GZ	Acceleration along the z-axis. Acceleration can be either positive or negative. Positive GZ acceleration is "headward" with a resultant inertial force from the head to the feet. Negative GZ acceleration is "footward" with a resultant inertial force from the feet to the head.
Individual response stereotypy	A pattern of electrophysiological responses that is characteristic of an individual under a specific stress.
Khilov swing	A four-support swing in which the occupant (seated) moves parallel to the ground when swinging back and forth.
Minnesota Multiphasic Personality Inventory (MMPI)	A nonprojective psychological test that measures for 10 specific psychopathologies.
Raven's Progressive Matrices Test (RPMT)	A nonverbal intelligence test that requires the subject to manipulate various patterns (matrices) according to a specified rule.
Thematic Apperception Test (TAT)	A projective technique in which the subject is asked to make up a story about each of a series of pictures. The theme of each story is then analyzed for the existence of sources of motivation.
Taylor Manifest Anxiety Scale (TMAS)	A psychological test that measures the level of anxiety in a person.
Weschler Adult Intelligence Scale (WAIS)	An intelligence test that contains both verbal and performance (nonverbal) subtests.

25X1

Appendix B

Psychological Tests Used by the Soviets and East Europeans for Selecting Cosmonauts

Table B-1
Summary of Tests

Test Name	Type	Format	Used by
Raven's Progressive Matrices Test	Intelligence	Multiple choice	Soviets, Poles
Weschler Adult Intelligence Scale	Intelligence	Multiple choice	Poles
Kraepelin Test	Intelligence	Arithmetic	Poles
"Bourdon" Test	Intelligence	Unknown	Poles
Thematic Apperception Test	Personality	Projective	Soviets
Taylor Manifest Anxiety Scale	Personality	Nonprojective	Soviets
Minnesota Multiphasic Personality Inventory	Personality	Nonprojective	Soviets
Cattell 16-Factor Personality Inventory	Personality	Nonprojective	Soviets, Poles
Eysenck Personality Inventory	Personality	Nonprojective	Soviets, Poles
"Paired verbal" Test	Personality	Projective (?)	Soviets
Visuomotor Coordinometer SMA-3	Psychomotor	Unknown	Poles
Cross Support	Psychomotor	Unknown	Poles
Chronometer	Psychomotor	Unknown	Poles
Test using the "Apparatus of Piorkowski"	Psychomotor	Unknown	Poles

25X1

Intelligence Tests

Raven's Progressive Matrices Test (RPMT) is a British nonverbal intelligence test used by both the Soviets and the Poles. It was first developed in 1938, but has been revised and updated many times. It consists of a number of multiple-choice tasks. Each task consists of a geometric design or "matrix" and four possible answers (that is, each answer is a different matrix). The correct answer depends on the required task (for example, complete a pattern or analogy, systematically alter a pattern, or resolve a figure into its parts). The test manual states that this test measures the capacity to form comparisons, analytical and logical reasoning, and, when timed, "mental efficiency."

25X1

The Poles use three additional intelligence tests from Western countries: the Weschler Adult Intelligence Scale (WAIS), the Kraepelin test (mental arithmetic), and the "Bourdon" test (unknown format).

25X1

One of the three tests, the WAIS, is American. It is a highly regarded intelligence test, first developed by David Weschler in 1955. It consists of two subtests (verbal and performance), each containing several sections. No details are available on the other two tests.

Table B-2
The Subtests of the Weschler Adult Intelligence Scale (WAIS)

Verbal Subtests	Performance Subtests
General information	Digit symbol
General comprehension	Picture completion
Arithmetic reasoning	Block design
Similarities	Picture arrangement
Digit span	Object assembly
Vocabulary	

Personality Tests

Again through NASA scientific exchanges with their Soviet counterparts, we have identified six personality tests that Soviet (and, in two cases, Polish) psychologists give their cosmonaut candidates. These are the Thematic Apperception Test, the Taylor Manifest Anxiety Scale, the Minnesota Multiphasic Personality Inventory, the Cattell 16-Factor Personality Inventory, the Eysenck Personality Inventory, and a "paired verbal" test. Five are Western (four American and one British).

The Thematic Apperception Test (TAT) was developed by Henry Murray at Harvard University in the 1930s. It is a "projective" test (see appendix A) consisting of eight to 10 pictures given to the subject one at a time. The person tells a story about the main characters in each picture. Theoretically, the person "projects" himself into the story. A skilled psychometrician can then gain insight into the specific personality characteristics that have been "projected." Murray developed the TAT to measure the "achievement motivation" of an individual, but it is commonly used to measure other psychological aspects as well. The Soviets may use the TAT to measure "motivation for spaceflight"—one of their stated aims in psychological testing—by this "achievement motivation" score.

Taylor Manifest Anxiety Scale (TMAS) also is used by the Soviets. It is an American psychological test developed by Janet Taylor Spence in the 1950s to measure anxiety. Spence, an American experimental psychologist, was concerned primarily with the relationship between anxiety and learning ability. The TMAS was developed to measure "anxiety" so that this relationship could be quantified. While the TMAS has been widely used to measure anxiety (usually within a clinical setting), its utility in this regard is not well established, even in the United States. 25X1

The Soviets use the Minnesota Multiphasic Personality Inventory (MMPI), a 565-question true-false test. 25X1 It was developed at the University of Minnesota to discover the presence of severe psychopathology (that is, neuroses or psychoses). It consists of 14 "scales," of which four (called the "validity" scales) measure the accuracy of the test for the specific individual being tested and the other 10 (the "clinical" scales) identify the type and magnitude of any psychopathology present. 25X1

The Soviets and Poles also use the Cattell 16-Factors Personality Inventory (16-PF). 25X1

The 16-PF was developed by Raymond Cattell at the University of Illinois. 25X1 It contains 187 multiple-choice questions and measures 12 "source traits" and four "2nd-order factors" (introversion versus extraversion, high anxiety versus low anxiety, emotionality versus poise, and subduedness versus independence). 25X1

The Soviets and Poles both administer the Eysenck Personality Inventory (EPI), which is a 1963 British modification of the Maudsley Personality Inventory (MPI), a British personality test. This test contains 57 yes-no items that measure introversion ("I" scale) versus extraversion ("E" scale), neuroticism (high "N") versus stability (low "N"), and degree of psychoticism (severe psychopathology). The three lettered scales and their interpretations are given in the following table. The EPI (as well as the MMPI, TAT,

25X1

Table B-3
The Validity Scales and Clinical Scales of the Minnesota Multiphasic Personality Inventory (MMPI)

Scale	Symbol	Characteristics
Validity scales		
"Cannot say" scale	? [a]	If high, may indicate evasiveness.
Lie scale	L	Measures the tendency to present oneself in an overly favorable or highly virtuous light.
Frequency scale	F	Composed of very unusual answers. A high score suggests carelessness, confusion, or claiming an inordinate amount of symptoms. Random responding also will elevate the F score.
Correction scale	K	Measures defensiveness of a subtle nature.
Clinical scales		
Hypochondriasis	HS	High scorers are described as cynical, defeatist, preoccupied with self, complaining, hostile, and presenting numerous physical problems.
Depression	D	High scorers are described as moody, shy, despondent, pessimistic, and distressed. Frequently elevated in clinical patients.
Hysteria	HY	High scorers tend to be repressed, dependent, naive, and outgoing and to have multiple physical complaints.
Psychopathic deviate	PD	High scorers are often rebellious, impulsive, hedonistic, and antisocial. They often have difficulty in marital or family relationships and trouble with the law or authority in general.
Masculinity-femininity	MF	Males scoring high on F are described as sensitive, aesthetic, passive, or feminine. Females scoring high on M are described as aggressive, rebellious, and unrealistic.
Paranoia	PA	Elevations on this scale are often associated with being suspicious, aloof, shrewd, guarded, worry prone, and overly sensitive. High scorers may externalize blame.
Psychasthenia	PT	High scorers are tense, anxious, ruminative, preoccupied, obsessional, phobic, and rigid. They frequently are self-condemning and feel inferior and inadequate.
Schizophrenia	SC	High scorers are often withdrawn, shy, unusual, or strange and have peculiar thoughts or ideas. They may have poor reality contact and in severe cases bizarre sensory experiences—delusions and hallucinations.
Mania	MA	High scorers are called sociable, outgoing, impulsive, overly energetic, optimistic, and in some cases amoral, flighty, confused, and disoriented.
Social introversion	SI	High scorers tend to be modest, shy, withdrawn, self-effacing, and inhibited. Low scorers are outgoing, spontaneous, sociable, and confident.

[a] "?" is here a symbol.

25X1

Table B-4
The Source Traits and 2nd-Order Factors of the Cattell 16-PF Personality Inventory

Factor	Low Score	High Score
Source traits		
A	"Sizothymia", reserved, detached, critical, aloof, stiff	"Affectothymia": outgoing, warmhearted, easygoing, participating
B	Low intelligence: dull	High intelligence: bright
C	Lower ego strength: affected by feelings, emotionally less stable, easily upset, changeable	Higher ego strength: emotionally stable, mature, faces reality, calm
E	Submissiveness: humble, mild, easily led, docile, accommodating	Dominance: assertive, aggressive, competitive, stubborn
F	"Desurgency": sober, taciturn, serious	"Surgency": happy-go-lucky, enthusiastic
G	Weaker superego strength: expedient, disregards rules	Stronger superego strength: conscientious, persistent, moralistic, staid
H	"Threctia": shy, timid, threat-sensitive	"Parmia": venturesome, uninhibited, socially bold
I	"Harria": tough, self-reliant, realistic	"Premsia": tender, sensitive, clinging, overprotected
L	"Alaxia": trusting, accepting conditions	"Protension": suspicious, hard to fool
M	"Praxernia": practical, "down to earth" concerns	"Autia": imaginative, bohemian, absentminded
N	Artlessness: forthright, unpretentious, genuine but socially clumsy	Shrewdness: astute, polished, socially aware
O	Untroubled adequacy: self-assured, placid, secure, complacent, serene	Guilt-proneness: apprehensive, self-reproaching, insecure, worrying, troubled
2nd-order factors		
Q1	Conservatism of temperament: conservative, respecting traditions	Radicalism: experimenting, liberal, freethinking
Q2	Group adherence: group-dependent, a "joiner" and sound follower	Self-sufficiency: self-sufficient, resourceful, prefers own decisions
Q3	Low self-sentiment integration: undisciplined self-conflict, lax, follows own urges, careless of social rules	High strength of self-sentiment: controlled, exacting willpower, socially precise, compulsive, following self-image
Q4	Low "ergic tension": relaxed, tranquil, torpid, unfrustrated	High "ergic tension": tense, frustrated, driven, overwrought

25X1

Table B-5

The Psychological Scales of the Eysenck Personality Inventory (EPI)

Scale	Symbol	Interpretation
Extraversion	E	High scorers are outgoing, impulsive, uninhibited, having many social contacts, participating in group activities.
Introversion	I	High scorers are retiring, distant, well-ordered, avoid excitement.
Neuroticism	N	High scorers are unstable and overreactive, emotionally overresponsive, have vague somatic complaints; low scorers are better adjusted and emotionally stable.

Note: The "E" scale and "I" scale are at opposite extremes of a common dimension. Therefore, high scorers on the "E" scale will be low scorers on the "I" scale, and vice versa. The "N" scale is independent of this dimension.

Table B-6
Soviet and Polish Psychological Tests Used for Selecting Cosmonauts, but Whose Function Is Unknown

Soviet	Polish
	Two-color digital manometer
Scale of reactive and personal anxiety (Spilberger method)	
Questionnaire (Strelyau's method "SAN")	
Method of corrective tests	
Method of black-red table	
Frustration test of Rosenweig [a]	
O-Sort test [a]	
Homeostatic procedure [a]	

[a] May be tests for group compatibility.

and the 16-PF) is used in the West primarily in clinical settings to aid or confirm a psychological diagnosis. [redacted]

The Soviets also describe the use of a "paired verbal" test. We do not know its exact nature, but it may resemble "word association" testing. [redacted]

Psychomotor Tests

Although we believe that the Soviets use psychomotor (for example, hand-eye coordination) tests, they have not given any specifics on them. However, Polish scientists have. They have mentioned four, namely, the "Visuomotor Coordinometer SMA-3" (probably a hand-eye coordination test), "Cross Support," "Chronometer" (probably a reaction-time test), and a test using the "Apparatus of Piorkowski." The specifics of each test are unknown to us. [redacted] 25X1

25X1

Other Psychological Tests—Function Unknown

In addition to those psychological tests already enumerated, Soviet and Polish scientists administer some tests whose function is unknown to us. [redacted] 25X1

25X1

Sanitized Copy Approved for Release 2011/01/12 : CIA-RDP84M00044R000200030001-5

Appendix C

Psychological Experiments During Soviet or Interkosmos Spaceflights

Sensory Experiments

Neptun

Concerned with the measurement of visual acuity and depth perception during spaceflight. We do not know the details of this experiment. The cosmonauts who have performed the Neptun experiment were Soviets, a Romanian, and a Mongolian. [redacted] 25X1

Guler/Vorotnik

Guler is described by Romanian scientists, and sounds very much like the Vorotnik experiment described by the Soviets for the joint Soviet/Romanian Interkosmos spaceflight. Guler/Vorotnik studied the evolution of space motion sickness. This sickness continues to be a major biomedical problem, especially during the initial adaptation to weightlessness. [redacted] 25X1

Ancheta (Questionnaire)

Consisted of a description of vestibular system symptomology that occurs during spaceflight. The cosmonauts who have performed the experiment were Soviets, a Romanian, and a Cuban. [redacted] 25X1

Vospriyatiye (Perception)

Vospriyatiye measured a variety of sensory functions such as tactile sensation, visual acuity, and "resistance to geometric illusions" (we do not know what specific illusions were presented). The Kontakt instrument, manufactured by Cuban specialists, was used in this experiment. The cosmonauts who have participated in the experiment were Soviets, a Cuban, and a Mongolian. [redacted] 25X1

Vremya (Time)

Concerned with accuracy in estimating time. In a description of the Vremya experiment, the Mongolian cosmonaut, Jugderdemidıyn Gurragcha, was said to have estimated an interval of 10 seconds without error (another of his estimates was 11 seconds). We have no idea why such a short interval was chosen for an estimate; gross errors would be highly unlikely for it. The cosmonauts who performed the experiment were Soviets and a Mongolian. [redacted] 25X1

Audio

To determine the sensitivity threshold of human hearing in spaceflight conditions. The Ehl'ba instrument was used. The cosmonauts who have performed this experiment were Soviets, an East German, and a Hungarian. [redacted] 25X1

Vkus

A study of taste sensitivity in weightlessness; conducted during the joint Soviet/Polish spaceflight. The equipment used was a small electrode which was clipped onto the cosmonaut's tongue and through which an electrical current was passed. [redacted] 25X1

Vision

Studied the functional state of the visual system during spaceflight. It was conducted during the joint Soviet/Cuban flight. [redacted] 25X1

Cognitive Experiments

Operator

Examined psychophysiological processes that reflect cognitive functioning (in this case, while solving arithmetic problems). The experiment used the Sedrets device, developed by Bulgarian specialists. The cosmonauts who have performed the experiment were Soviets, a Bulgarian, and a Romanian. 25X1

Rabotosposobnost' (Working Ability)

Designed to measure any deviations in intellectual working ability during spaceflight. Typically, it involved preflight, in-flight, and postflight testing. The experiment used the Balaton device developed by "Medicor," a Hungarian research institute, in collaboration with the Hungarian Military Flight-Medical Examination and Research Institute at the request of the Soviet Institute of Biomedical Problems, Moscow. The Balaton device can be connected to the Salyut telecommunications system for transmittal of results back to Earth in real time. During Rabotosposobnost' the cosmonaut was to choose one answer from four as quickly as possible based on the detection of a "signal" displayed by the Balaton device. The signal reportedly contained information about the correct answer (information measured in "bits," the commonly used unit of information). The cosmonaut's reaction time was measured by Balaton, and his "intellectual work capacity" was displayed in "bits/second." In addition, the Balaton device measured his GSR (see appendix A) and pulse rate. It appears that deviations in intellectual functioning were compared with deviations in these physiological responses for any possible correlations, a standard Soviet psychophysiological research theme. Wrong answers also were counted. The cosmonauts who have performed this experiment were Soviets, a Hungarian, a Cuban, and a Mongolian.
25X1

Reflex

Designed to measure cognitive functioning. It also used the Balaton device. The cosmonauts who have performed the experiment were Soviets, a Romanian, and a Hungarian. 25X1

Cortex

Designed to study the "bioelectrical activity of the central nervous system." It was said that Cortex involved "new methods for examining the level of alertness, attentiveness, fatigue, and also signs of possible impairments of the function of certain sensory systems" (in the form of brain electrical voltage shifts—known as evoked potentials—that occur as a result of stimulation). This experiment used the Korteks instrument, which was developed jointly by Cuban and Soviet specialists. The cosmonauts who performed the experiment were Soviets and a Cuban. 25X1

Psychomotor Experiments

Antropometria

Weightlessness redistributes blood toward the upper half of the body. One result is a change in the anthropometric measurements of the body. Another is a decrement in psychomotor coordination. This experiment was designed to measure this "psychomotor activity" during adaptation to weightlessness. The Koordinograph apparatus, developed by Cuban scientists, was used. The cosmonauts who performed the experiment were Soviets and a Cuban. 25X1

Coordination

This experiment (separate from the Antropometria experiment) was mentioned during the joint Soviet/Cuban spaceflight. It studied the effects of weightlessness on voluntary motor function. Preflight and in-flight results of a task were compared in which a cosmonaut, by turning two cranks simultaneously, sought to guide the point of a pen between the double outline of a geometric figure without touching the lines. 25X1

Experiments Concerned With Psychological Well-Being

Opros (Interrogation)

Concerned primarily with the influence of spaceflight on psychological well-being. The cosmonauts were required to answer nine questions, developed by Polish specialists, on such factors as sleep, appetite, cognitive functioning, leisure activities, and need for medication. Facial expressions also were studied. The cosmonauts who have participated in this experiment were Soviets, a Hungarian, a Pole, and a Mongolian. 25X1

Dosug

This experiment evaluated TV programs prepared as entertainment. The cosmonauts who conducted the experiment were Soviets and a Pole. 25X1

Relax

The GSR and pulse rate were monitored by the Balaton device. This time, however, the cosmonauts tried to achieve relaxation. The cosmonauts who performed the experiment were Soviets and a Pole. 25X1

Pruzkum

Used a questionnaire, the Supros 8, developed by a Czechoslovak behavioral scientist, Oldrich Miksik, of the Research Institute of Psychiatry, Prague. Its application to spaceflight was coordinated with the psychological support group of the Institute of Biomedical Problems, Moscow. Supros 8 asks for subjective evaluations and measures eight psychological parameters: (1) "P" (psychological well-being), (2) "E" (feeling of strength and energy), (3) "A" (desire for action), (4) "O" (impulsive reactivity), (5) "N" (psychological unrest), (6) "U" (fears or anxieties), (7) "D" (depression or psychological exhaustion), and (8) "S" (dejection or grief). The questionnaire was applied to Soviet cosmonauts, to a Czechoslovak cosmonaut, and possibly to a Mongolian cosmonaut, on four separate occasions: three days before spaceflight, the third day of spaceflight, and one day and eight days after spaceflight. 25X1

Page Denied

Next 6 Page(s) In Document Denied